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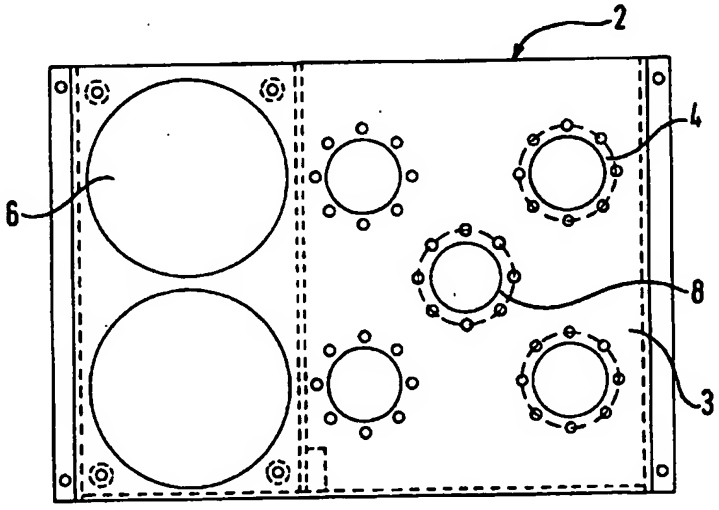

(57) Abstract

A system for communicating data by modulated beams of infrared radiation uses aligned transmitter and receiver units in which the integrity of data communication is increased compared with single transmitters and receivers by now using two or more transmitters facing two or more receivers, to give increased signal redundancy overcoming the effect of the interruption of a single beam. The output beam divergence from each transmitter may be changed by moving of a lens of desired type along the beam axis, and its direction changed by tilting the transmitter. The output beams may be caused to fall on substantially the same area, in order to increase the integrity of data transmission, or the areas may be caused to overlap each other partially to give rise to an area or areas of chosen shape at specified distances from the transmitter, with the same or different data being receivable at any point in those areas.

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INFRARED DATA TRANSMISSION SYSTEM

This invention relates to a data transmission system, and particularly to one in which the data are transmitted by modulating a beam of coherent radiation in the infra-red portion of the spectrum.

Data transmission systems employing a single infra-red transmitter in the line of sight of a single infra-red receiver are well known. One obvious example is in the remote control device for a television set, wherein the differently-modulated output signals of the remote control unit cause the set to change channels; to change the volume of the audio output, or the brightness of the picture, etc. Other systems are known in industrial settings, e.g. as described in EP-A-0034859.

One of the disadvantages of such systems often encountered is that the interposition of quite a slim object can stop the signals from being received and acted on. While this is of minor consequence in the domestic environment, it becomes of commercial significance when the data being transmitted are multiplexed telephone conversations or video signals. GB-A-2221810 describes

one way of avoiding loss of transmission due to atmospheric variations bending a beam between transmitter and receiver, but the solution described is complex involving feedback and beam switching between different emitters.

The present invention aims at increasing the continuity of reception of data-bearing signals transmitted by modulated infra-red beams over considerable distances, by using two or more transmitters at each transmitter unit, and two or more receivers at each receiver unit, with the same data being transmitted on each beam.

Accordingly the present invention provides a system for communicating data by the modulation and demodulation of a beam of coherent infra-red radiation, including a transmitter unit and a receiver unit each being sightable from the other, wherein the transmitter unit includes a housing, at least two separate transmitters mounted within the housing and means for adjusting the angle of the output beam from each transmitter to a limited extent relative to a front face of the housing, whereby the receiver unit may receive data from one or both transmitters. Preferably the receiver unit also has a housing which includes at least two receivers each including a lens adapted to focus incoming radiation on a photodetector.

The present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a view from the front of a combined transmitter/receiver unit of the present

invention;

Figure 2 is a view similar to Figure 1 of a different transmitter/receiver unit;

Figure 3 is a section on the line III-III of Figure 2, showing two parallel receivers and one transmitter;

Figure 4 is a scrap view of that part encircled in Figure 3, and drawn to a larger scale, and

Figure 5 is a plan view of a transmitter beam steering device shown in the previous figures, in which Figure 4 is a section on line IV-IV of Figure 5.

Although the basic equipment of the present invention would be a transmitter unit intended to communicate data unilaterally to a remote receiver, with each transmitter unit having two transmitters of modulated infra-red beams, and with each receiver having two receivers for such beams, in most commercial forms of the present invention it is envisaged that bilateral communication would take place between two transmitter/receiver (transceiver) units positioned remotely from each other but in line of sight of each other.

In that transmitter unit 2 shown in Figure 1, the transmitter unit has a housing 3 which includes four transmitters 4 of modulated infra-red radiation, and two receivers 6 intended to receive such radiation and demodulate it to extract the data. An optional feature shown in Figure 1 is the provision of an alignment device

8 intended to produce a visible beam which can be aligned optically with a common optical axis of the remote transceiver.

In the accompanying drawings, those components which are the same in different drawings retain the same references.

In that alternative transceiver 10 shown in Figure 2, there are two transmitters 4 and four receivers 6.

The manner in which the output beam is generated and modulated in each transmitter is generally known and does not form part of the subject-matter of this invention, and so is not described herein in any greater detail. This applies also to the manner in which the modulated signal impinging on a receiver is focused on a photodetector and demodulated to extract the respective data.

The transceivers 2 and 10 could be associated with each other when it is desired to transmit data with greater certainty in one direction along a two-way communication channel than in the opposite direction. The higher continuity of reception is ensured by modulating the four transmitters 4 of transceiver 2 with the same data, and arranging for each transmitter to be aligned optically with one of the four receivers 6 on transceiver 10. A lower degree of continuity of data transmission in the opposite direction arises from the fact that only two transmitters work in that direction, in co-operation with only two receivers. When the continuity of data transmission has to be very high and the same in both directions, the two transceivers would each have four

transmitters and four receivers.

Each transmitter 4 uses an infra-red laser diode 15 (Figure 4) to produce its output beam. In known fashion, the beam is modulated by the data to be transmitted, and the modulated beam falls on a lens 14 also carried by a mounting plate 16, which is in turn secured to a support flange 18 by means of three mounting screws 20. The manner in which the screws may be manipulated to steer the output beam are described below in connection with Figure 4.

In order to align two transceivers, such as 2 and 10, the transceiver 10 is provided with a tapped hole 12. Into this hole is screw-threaded a mount for a reflector, such as of the trihedral or ballotini type, which throws incident light back to its source. The laser in alignment device 8 (which may be steerable) is energised and housing 3 manipulated until a 'flash' of light from the receiver housing is observed, indicating that the tightly-focussed beam from device 8 is incident on the receiver. Thereafter the reflector is unscrewed to expose the adjacent receivers to incident infra-red radiation.

Each receiver 6 includes a large-diameter focusing lens 22 intended to receive the incident beam of coherent modulated radiation and bring it to a focus on a photodetector 24. As shown in Figure 3, both of the photodetectors 24 are mounted on the same printed circuit board 26, so that the positions of the photodetectors are predetermined by the manufacturer, and cannot be adjusted by the user. The demodulation etc. circuity does not form part of the subject-matter of this invention, and so

is not described herein in any greater detail. In practice it would lie close to the printed circuit board 26, being connected to it by leads which are not shown in the drawings.

As shown more fully in Figure 4, the output beam is steered by means of the adjustable mounting plate 16. The plate is secured to a support flange 18 by means of three screws 20 arranged at the apices of an equilateral triangle. This arrangement ensures that the mounting plate 16 can be tilted in any direction lying within a solid cone by differential rotation of the screws 20. To arrange for this, each screw is circumscribed by a helical compression spring 28, having one end bearing on the inside surface of flange 18, and the other end bearing on an opposite face of mounting plate 16. The function of spring 28 is to keep the head of screw 20 in rotary contact with flange 18, or with an anti-friction washer 30. In this way, rotation of the screw by a fixed angular extent is able to alter the distance between the flange and the mounting plate by an equivalent distance. The three screws may be altered by the extent and in the direction necessary to cause the output beam to have its axis aligned in a specific direction with respect to a normal to the front face of flange 18. In this way, while relatively coarse alignment of a transceiver housing with the remote transceiver can be achieved by clamping the housing itself, fine control of the output beams, to ensure that they fall on their respective receivers, is achieved by a adjustment of the output lens 14 of each transmitter. Each lens 14 is in a mount (not shown) which is screw-threaded for insertion in a screw-threaded opening 17 in a mount 16. Rotation of lens 14 is effective to move it along the optical axis of laser

15, so as to collimate its output beam or cause it to fan out over a small solid angle. Causing a beam to fan out reduces its effective range but gives greater latitude, by enabling data to be received over a wider area within the effective range.

Although only circular lenses 14 and 22 are shown in the drawings, it is within the purview of the present invention for all or any of the lenses to be substituted by a cylindrical lens. This ensures that the output beam of the respective transmitter has a cross-sectional shape which is other than circular. By this means, and by taking full advantage of the fact that each output beam is steerable, two, four or more individual output beams may be arranged to overlap each other partially at a desired distance to give an area of known shape corresponding to the envelope of the composite beams at that distance. Insofar as the transmitters may all be transmitting the same data, any receiver, whether single or multiple, positioned within that area and having its optical axis pointing towards the transmitter unit, can receive the same data while either stationary or travelling along that area.

Another unusual application of the present invention is to increasing the security of people travelling in lifts (elevators). Data relating to the security of people within the lift may be transmitted by the system of the present invention by attaching a transmitter to the external base of the lift, and aligning it optically with a receiver positioned directly below it. In this way data can be transmitted from the lift to remote security etc. personnel, and also in the opposite direction if desired, should the normal telephone in a lift be put out

of action for whatever reason.

It will thus be seen that the present invention provides a data communication system of high integrity, achieved by the use of multi-beam transmitters and receivers. By 'multi' in this specification is meant - two or more -. While the preferred system ensures high integrity of data transmission by using four data transmission beams from the same transmitter unit, the lower guarantee of integrity provided by the use of only two transmitters might be perfectly acceptable in some applications of the present invention.

Although in many applications of the present invention both or all transmitters of one transceiver would be transmitting the same data, this is not essential. The present invention encompasses both or all transmitters being aimed at different targets (which may be a single, fixed or mobile, receiver); being of different divergencies, and therefore of different effective ranges, and carrying different data.

CLAIMS

1. A system for communicating data by the modulation and demodulation of a beam of coherent infra-red radiation, including a transmitter unit and a receiver unit each being sightable from the other, wherein the transmitter unit includes a housing, at least two separate transmitters mounted within the housing and means for adjusting the angle of the output beam from each transmitter to a limited extent relative to a front face of the housing, whereby the receiver unit may receive data from one or both transmitters.

2. A system as claimed in Claim 1, wherein the receiver unit has a housing including at least two receivers, each including a lens for focusing incoming radiation on to a photodetector.

3. A system as claimed in Claim 2 in which each receiver includes a printed circuit board spaced from a lens, the board supporting a photodetector, with the lens and the photodetector being in fixed positions relative to each other.

4. A system as claimed in any one of Claims 1 to 3, in which each transmitter includes a lens which is adjustable along the optical axis to alter the degree of divergence of the output beam.

5. A system as claimed in Claim 4, in which the lenses associated with the transmitters are shaped and aligned to produce a combined output beam from the transmitter unit of desired envelope.

6. A system as claimed in any preceding claim, in which the transmitter unit includes four separate transmitters having their axes at the corners of a quadrilateral.

7. A system as claimed in any preceding claim in which the receiver unit includes four separate receivers having their axes at the corners of a quadrilateral.

8. A system as claimed in any preceding claim, in which associated with the transmitter is an alignment device in the form of a transmitter of a thin beam of coherent radiation.

9. A system as claimed in any preceding claim, in which each transmitter includes a mounting plate which carries a laser beam source and which is movably connected to a support flange by three screws which are accessible from the front of the transmitter unit, so that selective rotation of the screws is able to tilt the mounting plate to cause the central axis of the beam to extend in a desired direction.

10. A system as claimed in Claim 9, in which each screw is threaded into the mounting plate, and is a clearance fit in an aperture in the flange, and in which a spring between the mounting plate and the flange keeps the head of the screw in rotary contact with an outer surface of the flange.

11. A system as claimed in any preceding claim, in which each modulated beam in a transmitter unit is differently from that associated with the or any other transmitter in that unit, to reduce or avoid

modulation distortions.

FIG. 1

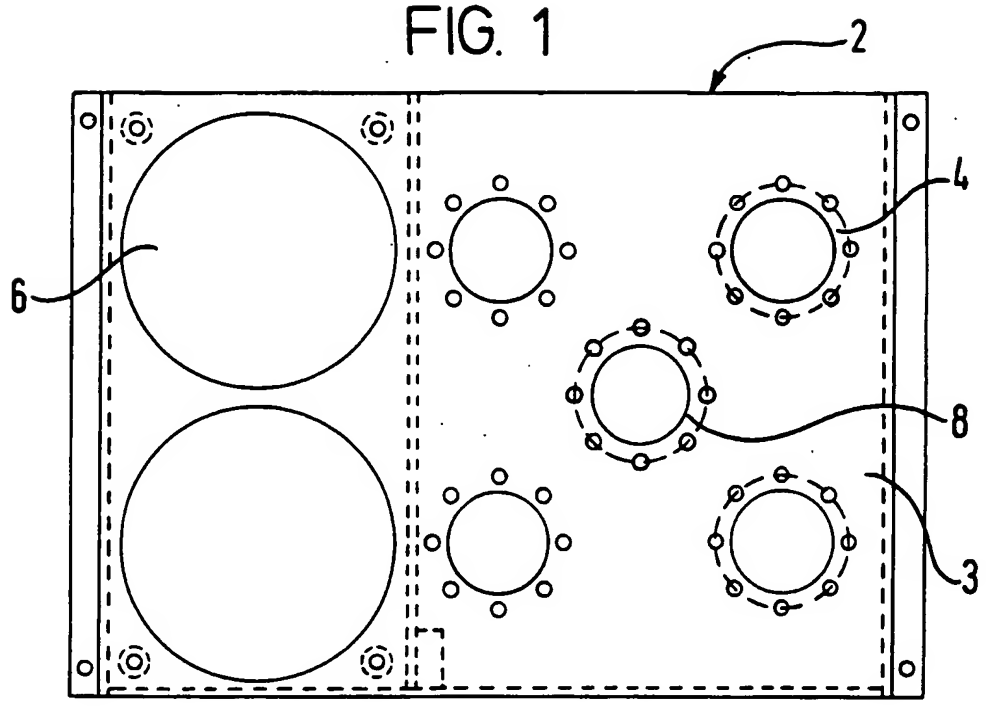


FIG. 2

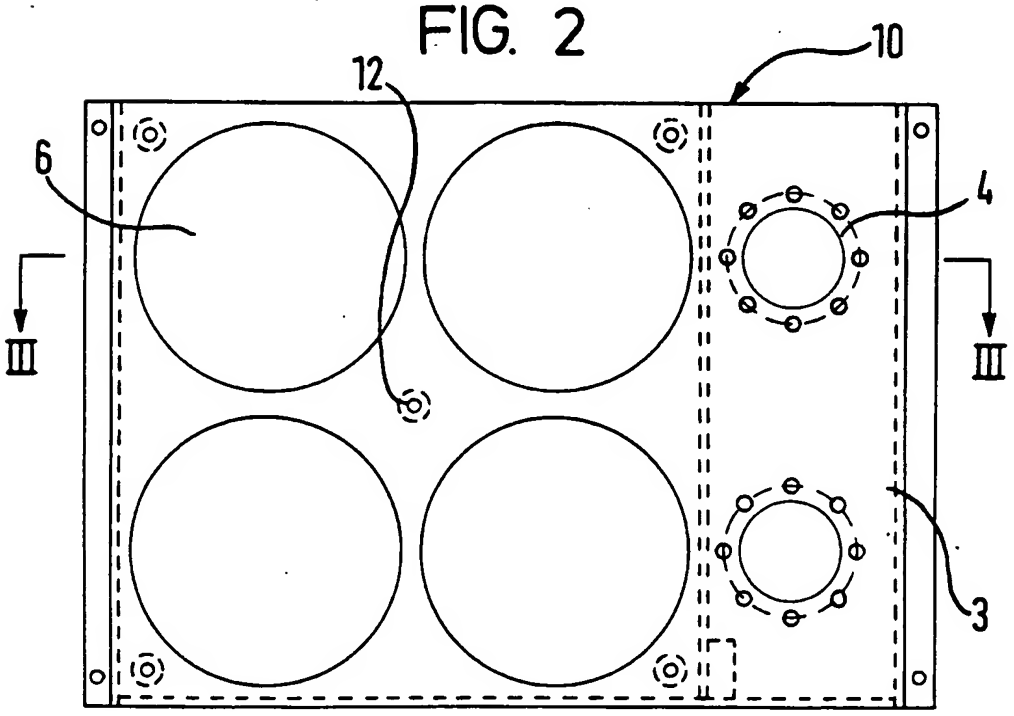


FIG. 3

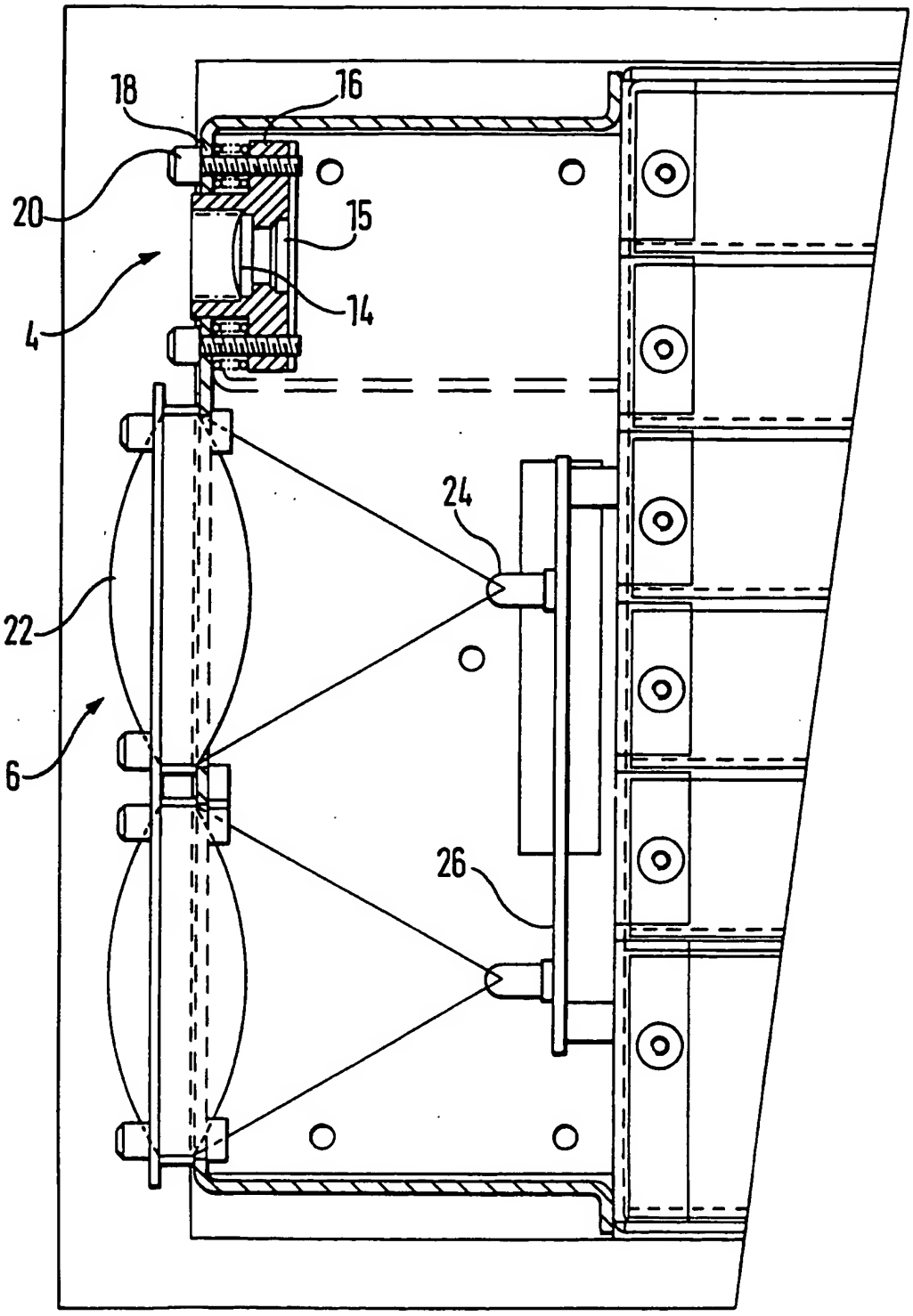


FIG. 4

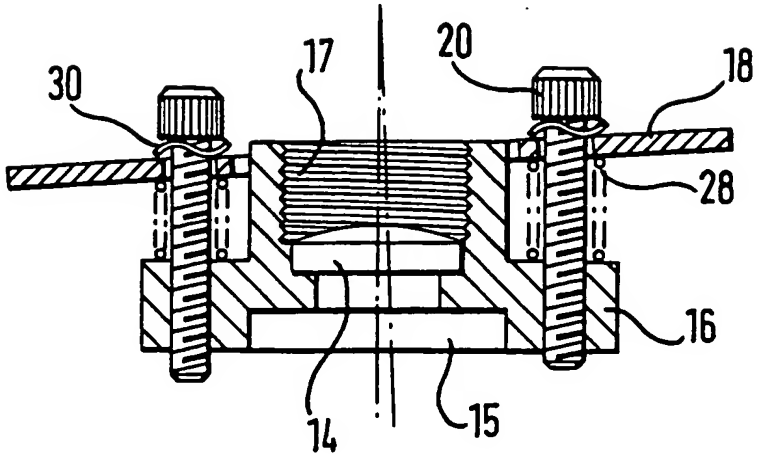
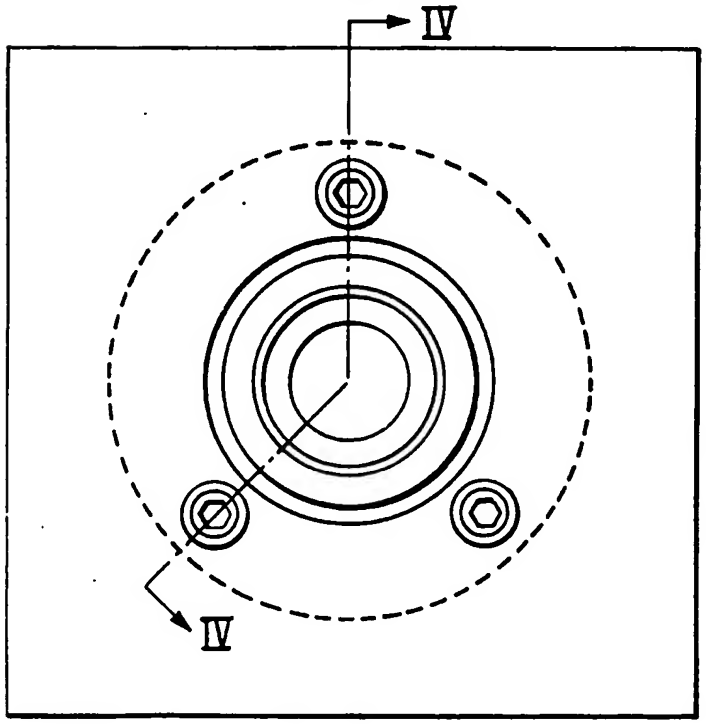


FIG. 5



INTERNATIONAL SEARCH REPORT

In tional Application No
PCT/GB 95/00167

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B10/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,94 01942 (MOTOROLA) 20 January 1994 see abstract; claims 1,7; figure 3 ---	1
A	EP,A,0 566 352 (SONY CORPORATION) 20 October 1993 see abstract; figures 1,2 ---	1,9
A	EP,A,0 434 004 (GTE LABORATORIES) 26 June 1991 see column 2, line 19 - line 44; figure 1 ---	1
A	GB,A,2 141 258 (MOTOROLA ISRAEL) 12 December 1984 see page 2, line 57 - line 68; figures 3,5,6 -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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9 May 1995	08. 06. 95

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Information on patent family members

In ..tional Application No
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		US-A-	5367398	22-11-94
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